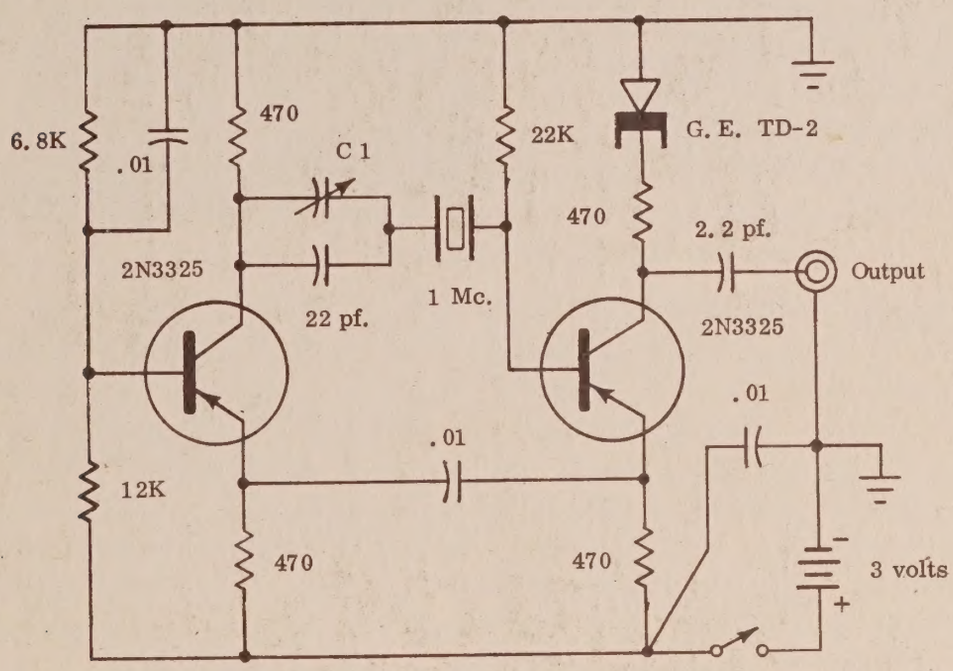
VHFER

50 MC. AND UP

LEARN BY DOING

Vol. 3, No. 5 May 1965



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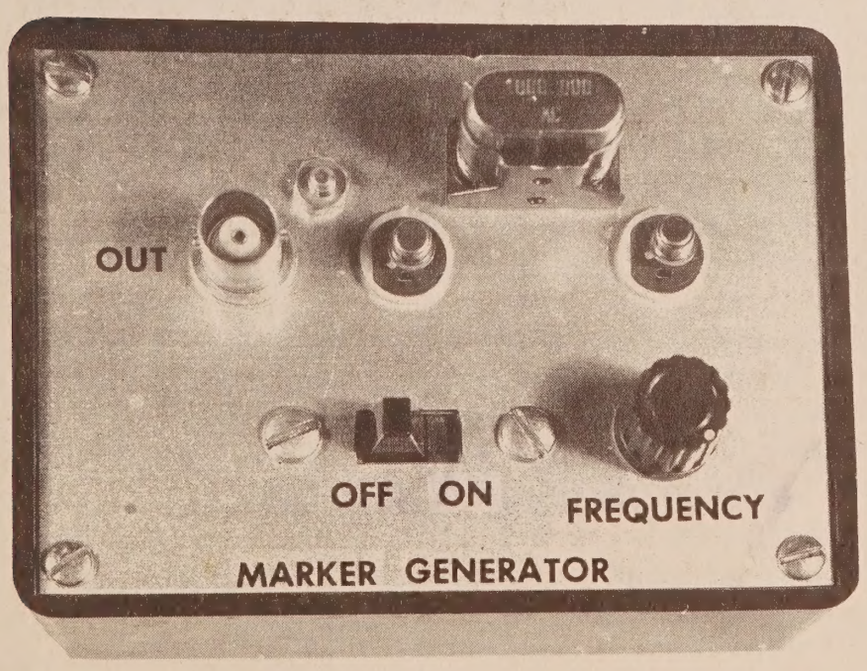

VHF-UHF MARKER GENERATOR

A PREAMPLIFIER THAT'S

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MODEL 432-2P

$25.00 postpaid

Noise figure under 6 db.
Over 25 db. of gain
50 ohms, in and out
Self-contained 9 v. battery
BNC connectors ONLY.
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The higher you go in frequency the harder it is to get agreement among both people and equipment on noise figure measurements. It has been our policy to get measurements made on our gear by competent, impartial engineers using the best noise-generating equipment available. Measurements on our Model 432-1 preamplifier using a 6CW4, ran 5.5 to 6 db. with selected tubes. Using a weak signal source to permit comparison, this transistor preamp. makes a noticeable difference in signal to noise ratio. Not a lot, but noticeable. We therefore conclude the improvement must be on the order of 1.5 db. or so. Using the noise generator it shows a 2 d.b. improvement but in view of the fact that our noise generator hasn't been compared with commercial equipment at this low a level we are reluctant to put a 4 d.b. specification on it. 6 db. is certainly very conservative. The 2N3399 transistors we use have been uniformly good. No selecting has been necessary. As for compared performance with other devices, it does every bit as well as W6NLZ's G.E. Planar Triode. That single tube costs more than this whole preamplifier.

You have to watch it about r.f. leakage into transistors. They burn out if you aren't careful. WA6MGZ runs 300 watts on 432 and has used a transistor preamp (home made) for a couple of years with no burn outs. But let's face it. Transistors are passing up tubes---and they're cheaper. The burnout problem can be whipped with proper relays and layout.

If you already have a converter for 432, even though it isn't too sharp, the preamp. is what you need. This is because sensitivity is determined in the front end provided you have adequate gain to cover mixer noise. If you play with ham TV, put this ahead of your UHF converter, peak it up, and you'll see a whale of a difference. Most TV converters are just diode mixers with terrible noise figures.

We also make modifications of our equipment for commercial use--at a higher price. Write for quotations stating exactly what you want to do.

PARKS ELECTRONICS LABORATORY • ROUTE 2, BOX 35 • BEAVERTON, OREGON

A VHF-UHF MARKER GENERATOR

By Mike Metcalf, W7UDM

An accurate receiver calibration is a must for the serious VHF DX man. The 100 kc. crystal calibrator in many receivers is no help at VHF because the crystal in the converter is usually off frequency a bit. Meteor scatter, moonbounce and extremely weak signal detection are next to impossible unless you know just where to listen for the signal. You can't tune around for it at random. Much of this kind of DX work is done near the low edge of the band or very close to 432 Mc. The dial calibration on most recent receivers is accurate enough to let you read frequency to within a kilocycle 20 or 30 kc. up the band once you know where the band edge is.

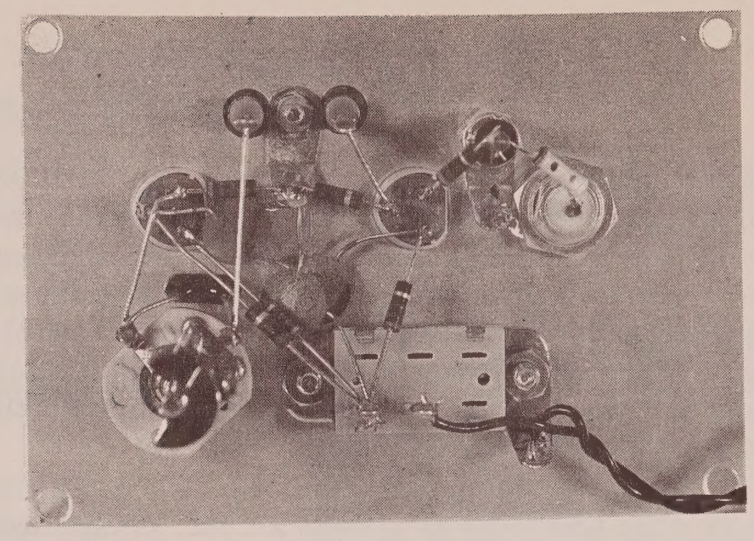
The usual way to spot the band edge is to build a 1 Mc. crystal oscillator and zero beat it with WWV. At the frequencies of 144 Mc. and above it is often difficult to get sufficient harmonic output to accurately mark the band edge. Also, if the receiver I. F. is an even multiple of 1 Mc., the receiver picks up a harmonic of the calibrating oscillator and you get more than one signal at the band edge. With overloading you may get several.

The calibrator to be described has the advantage of very high harmonic output--so much that you can pick up a signal from it without feeding its output directly into the converter. A short piece of solid wire stuck into the output connector will radiate adequately in most cases. Only one signal at every one megacycle interval is the result,

This calibrator uses a multivibrator and a tunnel diode in a switching circuit. Now tunnel diodes may be difficult to work with as oscillators and amplifiers, but as a switch they are simple. And as a switch the tunnel diode is so fast it is very difficult to measure how fast it really is. Switching time of a device like the TD-2 used in this circuit is on the order of a thousandth of a microsecond. A switch that operates in zero time generates an infinite order of harmonics of the switching repetition rate. This is just what we want for a marker generator. By driving the tunnel diode at a 1 Mc. rate there is plenty of marker signal every 1 Mc. from 1 Mc. to well above 1296 Mc. So if you know the location of the band edge on your receiver to within a hundred Kc., this marker generator will let you calibrate every megacycle to an accuracy limited only by your ability to zero the marker generator against WWV.

The circuit diagram is on the front cover of this issue. It has a multivibrator utilizing two high-frequency transistors that includes a crystal in the feedback path. The repetition rate is controlled by the 1 Mc. crystal. The current in the collector of the second transistor varies from zero to about 3 ma. The tunnel diode is in series with this collector so current through the tunnel diode must vary in the same manner. This particular tunnel diode has a peak current of about 2.2 ma., so when current exceeds that amount it switches from its low-current stable state to the high-current stable state. When the current in the second transistor's collector circuit falls to near zero, the tunnel diode switches back to its low-current state. The operation of a tunnel diode in the switching mode is beyond the scope of this article, but it should be pointed out that you cannot substitute a diode of any other type and get the same effect because a tunnel diode is a negative resistance device and not of the type usually encountered.

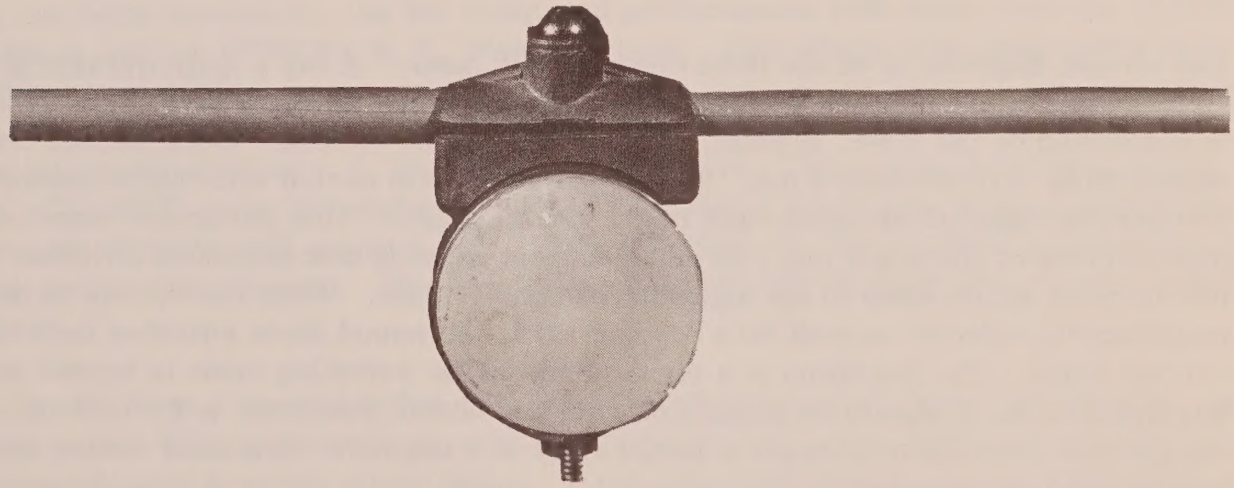
The use of transistors results in a compact and relatively inexpensive unit. The only critical point is the wiring of the tunnel diode. The 470 ohm resistor and 2.2 pf. capacitor should be wired in first. The tunnel diode must be protected from the heat of the soldering operation. When you solder it in place (use short leads) be sure to clamp the wire next to the device with long-nosed pliers to act as a heat sink. A lead length of 1/2 inch each side of the tunnel diode is acceptable. The outer shell of the tunnel diode should be grounded, preferably near the output connector.



How much capacitance you need in series with the crystal depends on how far off frequency it is in your particular circuit. It may be necessary to change the value of the fixed capacitor so you can zero against WWV with the variable capacitor near the center of its tuning range.

If you have a junk box, construction cost should not exceed $5.25. The transistors are made by Motorola and cost 90¢ each. The tunnel diode (TD-2 or 1N3714) is made by G.E. and costs $3.30. Resistors may be 1/2 watt or smaller. Any box or flat piece of metal may be used in the construction. Printed circuit board works well for this sort of thing.

The accuracy of the markers is entirely dependent on the care used to zero WWV. A 10 cycle error at 10 Mc. is an error of 144 cycles at 2 meters and 432 cycles at 432 Mc. In order to zero accurately to WWV you must use a meter. The ear does not respond well to low frequencies. The receiver "S" meter can be used to compare the signal from the calibrator with WWV and permits adjustment to within 1 cps when the tone is off. End.



ANTENNA ELEMENT MOUNTS

Four for $1. Fit standard TV mast and elements 1/4" to 3/8". See ad in April VHFER.

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ODDS & ENDS ABOUT 432 MC.

By Loren Parks, K7AAD

The big dish in Arecibo, Puerto Rico (KP4BZ) will be operated on 432 only the 3rd and 4th of July. Operating times will be when the moon is within range of the hemispherical reflector. No more details available yet. Info. from W1HDQ. Of course, July 3 and 4 is during the A. R. R. L. national convention at San Jose and the west coast V. H. F. conference. With all the big 432 antennas that will be present, no doubt something will be set up to listen for moon bounce and hopefully to transmit. Last time I believe the pile up right near 432.000 was pretty bad so it might be a good thing to move off a bit. Remember that with all the gain on that end it doesn't take so much suds on your end. C. W. is probably the mode to be used but in view of some rather good results with fone last time it might be they'll be able to copy a good s. s. b. signal.

Locally, some hams have built a 16 element extended-expanded collinear antenna with a copper screen reflector. Gain measurements were made in the same manner as described in the tests on the Skybeam in this issue. The same reference dipole used at the west coast antenna measuring contests showed the antenna had about 18 d. b. gain. This seems too good to be true and we have been making checks on the dipole and will also make comparisons against the Gibson Yagi which I take to all the contests. At any rate, though gain may not be 18 d. b., the antenna apparently works well and if further tests show it is performing as an antenna of that size should, we will publish constructional details. The extended-expanded collinear was a contribution of the late Oliver Wright, W6GD. This type antenna has always won the contests. Two versions of it are described in the VHF Handbook by Frank Jones (CQ). One was used as a pattern for the antenna made locally. The screen was substituted for reflector elements. The screen reflector probably has too much wind resistance to keep in the air but for moonbounce it seems ideal.

You haven't been seeing much in the way of converter construction articles in VHFER. It isn't that we suppress it, it's just that suitable articles have only recently been submitted. We had plans of presenting a 432 transistor converter article this month, a re-do of an article in the Sixth Army MARS bulletin, but the author decided he wanted it published elsewhere so no article. This seems like an appropriate time to say something about guidance and quality control in VHFER construction articles. A responsibility Fred Brown (W6HPH) and I feel is that it is up to us to see that information presented is reasonably accurate and leads in the direction of up-grading the ham and his station. As a result of the yearly get-togethers the more advanced west-coast hams have to exchange views, measure the performance of receiving equipment on 2 and up, measure antenna gains on 432 & up, we pretty well know what stuff works and how well it works. Though measurements may not be absolute they are certainly useful when a large number of comparisons are made. A year or so ago, the 6CW4 (selected), 416B and Philco 2N2398 all performed essentially the same at 432. Note that the 8058 was not included. How much was the fault of the tube and how much the fault of the builder, we don't know. All we know is that none made a good showing. Now the Amperex 2N3399 and W6NLZ's planar triode are tied and ahead of the former champs. The planar triode and its associated power supply are so expensive as to be out of the question for most and certainly offer no advantage except perhaps that they will tolerate more r. f. leakage thru the coax relay. The 2N3399 is cheap ($2.55) and in our experience they all work fine with noise figures by our measurements (which may well be off) of about 4.5 db. At any rate they're darned good. Now knowing all this, would you solicit or accept articles about HOT converters or preamplifiers using the 416B (which goes sour easily) or the 8058 (which costs $13.50)? We don't. There is a place for a mediocre converter for 432 that is easily built from readily available, inexpensive components. It has to be stable so it can be used with a good preamp. We have two such articles contributed that will be published shortly.

Last February when I was in Boston, W1OOP and W1BU told me of their work with selected RCA 2N3478s. We bought some locally, re-worked our preamps to cater to the NPN and

results were awful. We got 9 db. noise figures. Maybe we got bad ones or maybe we did something wrong. Not a lot of time was spent on the project. We sent Sam Harris one of our standard preamps to compare with his RCA job to see if it was really a difference in performance or a difference in noise figure measuring techniques. That was in March (Sam hates to write letters) and now he is in Arecibo so we won't know for a while.

At 432, transmission line losses can get pretty bad. Those with permanent towers can sometimes get industrial surplus air line coaxial cable that has extremely low losses at 432. The stuff is rigid and not very suitable for crank-up towers like I have. For those of us who have to live with flexible coax, it would seem very desirable to put the preamp up at the antenna to get another 2 or 3 d. b. of signal. This means special switching, preferably something that also shorts the input of the preamp. while the final is running. We are in correspondence with Dow-Key to see what can be worked out. If we can prove to our own satisfaction that the system is safe for use with transistors we'll let you know about it. Some surplus relays have very good isolation and are quite satisfactory. Transco is one brand that is good. However finding them in any quantity is the problem. The burnout problem has to be solved. Tubes as VHF-UHF front ends have had it.

Open Bands

By Marilyn Wiseman, K8ALO

144 MC.

April 16 WA8KBJ (Royal Oak, Mich.) worked WA8GKK (Port Clinton, Ohio) 100 miles at 2327

April 18 WA8KBJ reports an aurora from 0130 to 0630. Hrd W3LNA, W9PBP, W8GZW, W8KAY, WA9CIY. Wrkd K9SGD (Sparta, Ill.) 470 mi., K9IMX (Bloomington, Ill.) 315 mi., K9HMB (Chicago) 225 mi., VE3EWZ (Toronto) 200 mi., K2LGJ (Buffalo) 215 mi. Time: 0230 to 2355.

April 22 K3GGZ (Enon Valley, Pa.) reports wrking K8IFE (Richmond, Mich.) 200 mi., K8DBA (Monroe, Mich.) 175 mi., WA8KBJ (Royal Oak, Mich) 180 mi., VE3AJU (Bright's Grove, Ont.) 250 mi. Time 2104-2208.

April 23 K3GGZ (Penna.) wrkd VE3FRC (Sarnia, Ont.) 225 mi., VE3BVK (St. Thomas, Ont.) 150 mi., W8JXU (Hazel Park, Mich.) 180 mi., WA8HTL (Detroit, Mich.) and K8DBA (Monroe, Mich), both 175 mi. Time 2321-0050.

April 24 K3GGZ (pa.) wrkd K8PSH (Roseville, Mich.) 185 mi., W8PHJ (White Lake, Mich.) 240 mi. 2137-2256. WA8KBJ (Mich.) wrked K3FOO (Sharon, Pa.) 150 mi., K8RPB (New Cumberland, West Va.) 175 mi. Time 2115 to 2141.

April 29 W3GLC (Beaver, Pa.) wrkd K8TCA (Horton, Mich) 200 mi. at 1930.

May 1 WA8KBJ (Mich.) wrkd K8TVT (Steubenville, Ohio) 300 mi. at 0245.

May 5 K3SBE/3 (Jeanette, Pa.) wrkd VE3EYX (Blenheim, Ont.) 230 mi. at 2226. WA8KBJ (Mich.) wrkd K3PGP (Irwin, Pa.) 215 mi. at 2142.

50 Mc.

May 6 VE4GI wrkd CO2DL. Hrd 30 states in 36 hours.

Send ur dx reports to Box 103, Petersburg, Ohio. Let's keep minimum distance of 250 mi. on 6 & 2 next time. DX in the midwest is much different from northwest and we don't yet know whi distances are exceptional. 432 & up--you be the judge.

K9EID OFF THE AIR TEMPORARILY

The fb station of Bob Heil in Marissa, Ill. is closed down due to a job change and impending matrimony. Bob has joined the Holiday Inn chain & present plans are to have new QTH on top of 33 story Holiday Inn on Lakeshore Drive in Chicago. Should shake things up in Chicago.

MEASUREMENTS ON THE 2 METER TEN ELEMENT "SKYBEAM" MADE BY "J" BEAM AERIALS, LTD.

By Loren Parks, K7AAD

NOTE: This article is a re-run of one that appeared in VHFER in Sept., 1964. In view of the facts that we have over a thousand more readers and that this is antenna-testing season, it seems appropriate to run it again. This antenna is still by far the best commercial beam I have tested. All elements are "working" elements. I'm well pleased with it and so are a couple of sneaks who copied its dimensions while it was on the ground and I was gone. The beam is distributed in the U.S. by Gain, Inc., one of our advertisers.

In one of my previous VHFER articles I intimated that the claims of some antenna manufacturers were less than hones, by several db. Bill Roberts of Gain, Inc. took it upon himself to prove I was mistaken as far as his line was concerned. He challenged me to measure his Skybeam and I accepted. Later, after I had made a report on it to him, he sent me a very well written booklet put out by J Beam Aerials which showed my measurements were very much in agreement with theirs and that their claims were indeed well-founded. Rather than make this article simply a strong sales pitch for this beam (which I later bought) I would like to go through the measurement method with you and discuss some of the design characteristics of the Skybeam and of Yagi antennas in general. I want to do this because I know full well that the pathway to better dx is more likely to be through the antenna than through improvements on any other part of your equipment, once you have a reasonably good converter, receiver, transmission line and a few hundred watts output power.

Antenna gains are stated as being so many d.b. over a dipole or over an isotropic radiator. An isotropic radiator is a theoretical antenna which puts out radiation equally intense in all directions. Of course a dipole doesn't do that nor does any antenna. But to make an actual gain measurement a reference antenna is used and the dipole is convenient. When you look at antenna specifications be sure you know if gain is specified as being over an isotropic radiator or a reference dipole. An antenna with 10 db. over a dipole has more gain than one 10 d.b. over an isotropic radiator. If the specification says 10 db. over isotropic subtract 2 db. (approximately) from that figure to get the gain over a dipole. I still say that when you read specifications on amateur antennas, be very skeptical of gain claims. Sometimes gains are (mis)calculated and not actually measured. Not all manufacturers of antennas are competent. Not all are truthful.

I measure antenna gain by comparing the relative ability of two antennas, the dipole and the antenna under test, to deliver power to a known load (a 50-ohm 1/2 watt carbon resistor.) The set-up I used to test the Skybeam is illustrated in Fig. 1.

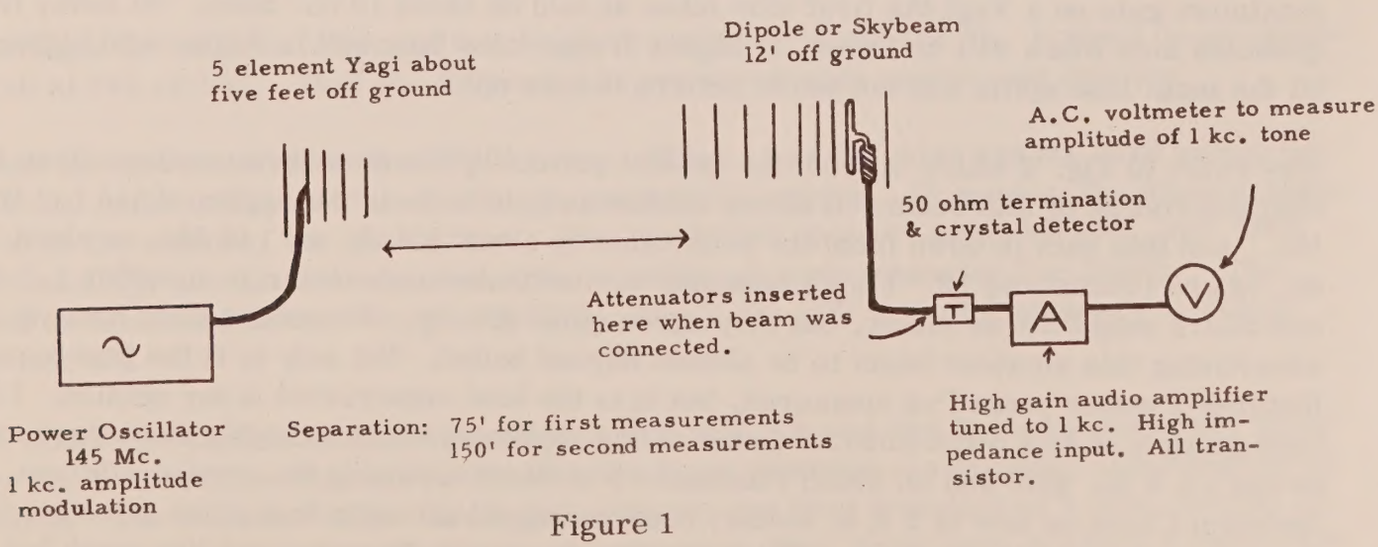


Figure 1

First I raised the dipole to about 12 feet and read the meter on the output of the narrow-band audio amplifier (peaked at 1 kc.) This reading was used as a reference. Then I disconnected the dipole and attached the coax line directly to the balun on the beam so that the coaxial line would be the same length in both measurements. I put up the Skybeam to the same height and of course the meter read off scale. So I inserted coaxial attenuators (shown in Fig. 2) just ahead of my 50-ohm resistive termination and rectifier box until the meter reading was the same as it was with the dipole. To make the meter reading the same as before I had to use 12 db. of attenuation. Therefore the Skybeam was extracting 12 db. more power from the passing wave than the dipole. Only two calibrations are involved in this method--the dipole and the attenuators. The dipole was checked for match and for a symmetrical pattern on an antenna range (April 65 VHFER.) I have a good selection of attenuators and have compared them against each other and believe they are accurate. No matter what may happen to the amplifier with respect to its gain from day to day or week to week, as long as the gain stays constant between comparisons of the dipole and the antenna under test, it does not enter into the measurement at all.

You probably question the accuracy of gain measurements made so close to the ground. There are always problems in making gain measurements unless you're out in free space. The usual problem is ground reflections or reflections from surrounding objects. I was in a large, open field. I had the transmitting antenna fairly close to the ground so that the path to the antennas used to receive would be about the same length whether the wave went directly from the source or was reflected off the ground. This minimizes cancellation or enhancement of the received signal due to interaction of the direct and ground-reflected waves. Also I used a small beam as a source to more or less focus the signal toward the receiving antennas and minimize signal radiated toward the ground.

To test for ground reflections, I moved both the dipole and the beam up and down several feet and sideways too in the test area to note the difference in the received signal. The difference was not appreciable as long as the antenna height remained constant.

Then I moved the entire receiving test set-up another 75 feet away and re-measured, getting the same results for gain. I did not test for side-lobe or front-to-back ratio a second time. Of course I measured 2 or 3 times in each location, never depending on a single reading.

When I measured the first side lobe level, I measured with reference to the forward gain. I got about 16 db. below the main lobe. The back lobe was about 17 db. down from the forward lobe.

From the side lobe level, down 16 db., I guessed that the beam probably had more gain at a higher frequency than the one at which I was measuring, 144 Mc. The reason is that for maximum gain on a Yagi the first side lobes should be about 10 db. down. At lower frequencies side lobes will be lower, at higher frequencies they will be higher and higher until the main lobe splits and the whole pattern breaks up.

Now refer to Fig. 3 which is from the booklet put out by the manufacturer describing the characteristics of this beam. It shows maximum gain to be in the region of 146 to 147.5 Mc., and that gain is down from the peak value by about 3/4 db. at 145 Mc. or about 12.5 db. where I measured 12. I don't consider my measurements accurate to within 1/2 db. and theirs might not be either, but they agree quite closely. I consider their honesty in advertising this amateur beam to be almost beyond belief. Not only is it the best manufactured 2 meter beam I've measured, but it is the best constructed in my opinion. I had been using a 14 foot boom antenna (same as the Skybeam) which is highly advertised as having 15.5 db. gain and on which I measure 9 at the most under the same conditions. The Skybeam I have up now is 3 d.b. better, doubling signal strength in a given direction and doubling received signal power. That's half an S unit. It doesn't sound like much but it's the same effect you would have on a distant receiver if you doubled your transmitter power.

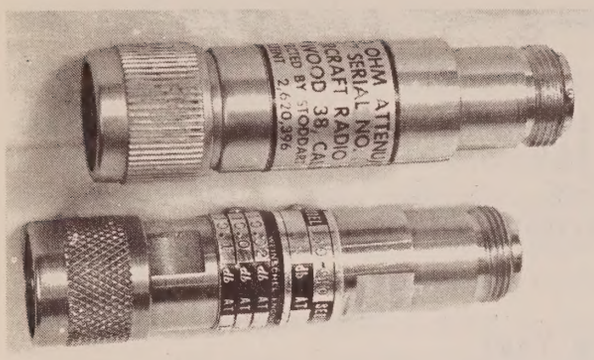


Fig. 2 Fixed attenuators

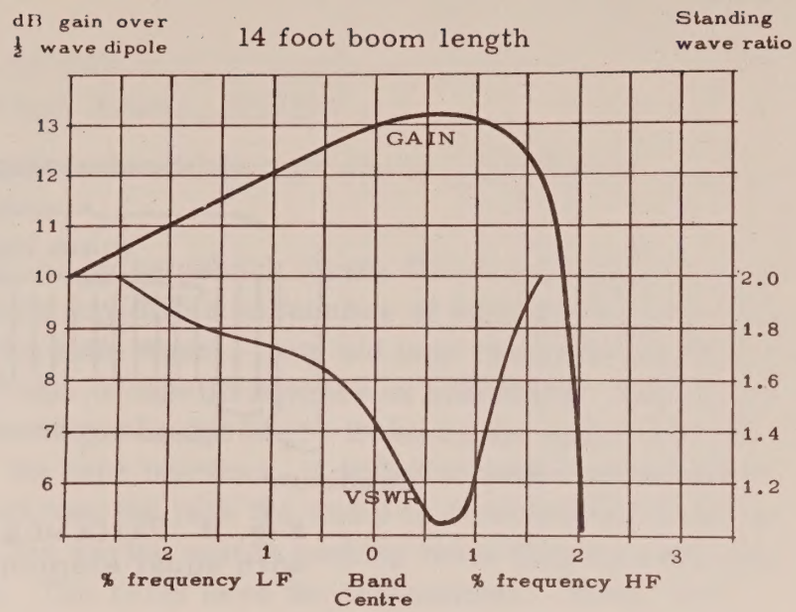


Fig. 3
Ten Element 2 Meter Skybeam

Now there are some things I should clear up so you don't get the wrong impression.

1. There is no collusion between the distributor or manufacturer of the Skybeam and myself. I don't operate that way. I bought the beam and balun after testing it because it was considerably better than what I had been using and was very ruggedly built. I bought the 2B52 balun to go with it and suggest if you buy the beam you do the same.

That combination works, I'm sure. If you use some other combination you may not get the performance I did. For the record, I'd like to say that I do not go along with much of what is written about open wire lines in this and other amateur magazines (in the past.) Moon bounce was done with coax. DXers I know use RG 8/U, RG 17/U or 200-ohm Federal line. I don't know any VHF DXers on the west coast using open wire line and I am acquainted with most of them from Canada to Mexico. Open wire line properly used in some situations is no doubt superior to coax. But at two meters coax will do a better job in the hands of a fool. That's why I use it.

2. If you have an antenna with 9 db. gain and you put up this one as recommended, signals which were marginal with the other beam aren't going to jump out of the speaker at you when you hook up this beam. 3 db. just doesn't make that much difference. It's twice power and worth having, but it takes 6 to 10 db. to make a pronounced difference. To get 6 to 10 db. improvement you have to pick up decibels wherever you can get them. There's no place you can get them any cheaper than in the antenna unless you already have a monster that works. Remember, the 3 db. gain benefits you by essentially doubling the other fellow's power as well as your own.

3. Don't get the idea that because this beam is peaked at about 146 Mc. it won't do an excellent job at 144 or 145. That db. difference is not discernible to your ear or mine.

4. Don't be concerned about the VSWR curve. When I use the balun and my Bird wattmeter at 144.05, reflected "power" indication is practically nothing. Of course, the place to measure is at the antenna, but few do that. Also, reflected "power" is not all lost, and SWR meter readings are not to be trusted without additional tests (changing line length.) The method is described in the Nov. 64 VHFER. At a 1.6:1 VSWR, reflected power is only a little over 5%.

Now I would like to discuss this antenna's design with you and why it works---and why many others don't. First, a Yagi is divided into two basic sections---a launcher and a slow-wave structure. The launcher is the dipole and reflector (or first director) as a rule, but can be a corner reflector antenna, a V antenna or numerous other types used to excite a slow-wave structure which is the string of directors.

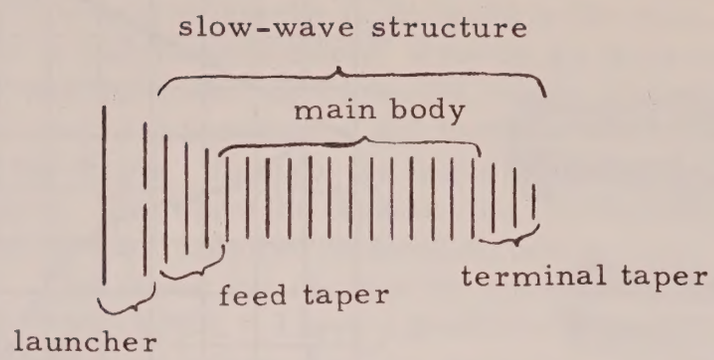


Fig. 4 Parts of a long Yagi with equal element spacing.

Looking at the antenna as a receiver of the passing wave front, the wave is slowed as it enters the front part of the Yagi and travels down to the dipole. The velocity of the wave as it travels along the Yagi is extremely important. The wave arriving from the string of directors must have a certain phase relationship to the wave which arrives directly from free space to show maximum gain. In other words there is a phase shift occurring in the Yagi which is caused primarily by the length of the directors and their spacing. When there is not enough phase shift (phase velocity too fast) the antenna has gain but not the maximum possible. The gain drops very rapidly when there is too much phase shift. Longer directors and closer spacing causes more phase shift or slowing of the traveling wave (if boom length is constant.) Now look again at the chart of Fig. 3 and note how steep the curve is on the high frequency side. This response curve is characteristic of a Yagi type structure. Variations may be caused by different tuning or feeds. A signal at 151 Mc. would be slowed much too much by the Skybeam and therefore the antenna would show little gain there. At 140 Mc. it would still show good gain. This curve and the preceeding discussion are intended to show you why you can't just add more elements to a properly designed Yagi and make it work better. You can only make it worse. If you want to increase the gain of a properly designed Yagi you have to add more to the boom length and readjust everything for optimum phase velocity by changing element lengths, spacing between elements or both.

While phase velocity is extremely important in a Yagi there are other things too. On a Yagi several wavelengths long a high-performance antenna often has 3 parts to its slow-wave structure. The main body, the terminal or end taper and the feed taper, as shown in Fig. 4.

A wave traveling at the speed of light does not couple well into a dipole or dipole reflector combination. If it is slowed down it couples much better. The purpose of the feed taper is to slow the wave considerably for better coupling. You can think of it as a matching network. To slow the wave or "match" it from the main body to the dipole you must put the elements closer together, make them longer or do both. But you still have to keep the total phase shift along the array the same or nearly so. That means increasing the wave velocity somewhere else. The Skybeam has all directors of equal length, so they are spaced more closely near the dipole to slow the wave.

At the far end of the Yagi, in the transmitting case, the wave must suddenly change from the velocity along the directors to free space velocity. It couples to space better when the wave is speeded up, so elements are often shortened near the end or spread farther apart. If the transition is too abrupt, a portion of the transmitted wave is reflected from the end and causes a higher backlobe level

The Skybeam does not have an end taper. It does quite well without it and I suggest you do not try to put one on it for fear you'll foul up the phase velocity. When you're building your own beams you could try the tapers, especially the feed taper. End.

AN AUTOMATIC KEYER FOR METEOR SCATTER

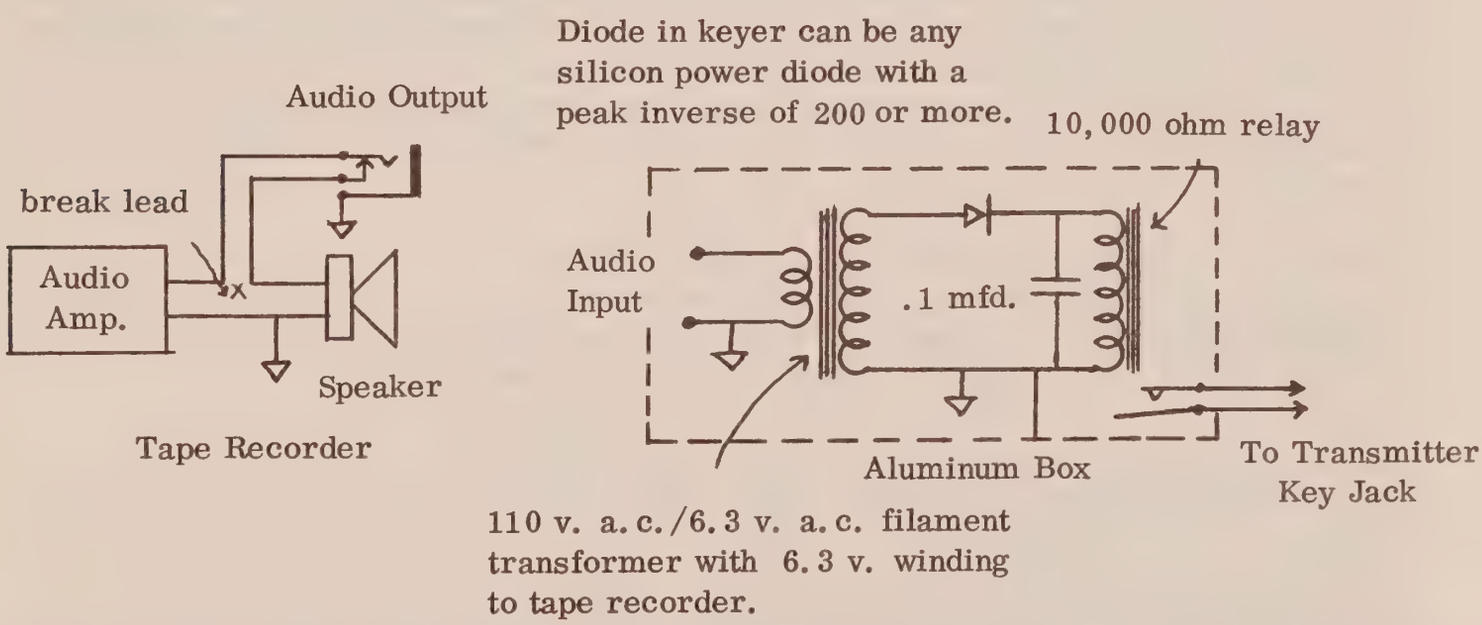
By "Skip" Freely, K6HMS

Have you ever run seven and one-half hours of solid meteor scatter schedules? I have, and this device was built to alleviate such pain.

This simple keyer will find constant use in any hamshack where CW is employed, and particularly on meteor scatter schedules. Since any different number of keying sequences may be used, this device is more practical than a code wheel. Any old tape recorder can be used, and it is very easy to make up endless loops of tape in advance of schedules. Generally, I key an audio oscillator into the tape recorder microphone to make up the tape, then use common "Scotch" tape to splice the ends of the tape together. I added an audio output jack to the recorder, so that when a plug is inserted into the jack the audio is disconnected from the speaker and goes into the keying unit. The keying unit is nothing more than an audio rectifier, simple filter, and sensitive relay. The relay keys the transmitter. Easy, no?

Examples of tapes I have used include "K7AAD de K6HMS", "CQ NW de K6HMS", "VVV QRA de K6HMS", with the message repeating. On meteor scatter I use a 1 RPM synchronous motor which turns on the transmitter for 30 seconds, and off for 30 seconds. Of course this is synchronized with WWV. Any number of schemes may be used, but this one is very successful. The only trouble I've had is with pickup of stray r. f. on the audio leads ahead of the relay. The r. f. is rectified and erratic keying or a hard-keyed condition will exist.

There are many other ways of adapting this to your requirements. I originally packaged the keyer in a little aluminum can, but I built this circuitry into my present exciter. I also suggest a small tape spool be placed on the tape loop to keep a little tension on it and keep the recorder from eating up your loop. The recorder should be standing vertically so that the loop is not rubbing against anything.



METEOR SCATTER SKEDS WANTED

WØEYE Don Hilliard P. O. Box 563 Boulder, Colorado 80301
W6DNG Bill Conkel 4608 La Cara Long Beach 15, Calif.
WA6QQI Doug Beck 925 Redwood Ave. Sunnyvale, Calif.

OBSTACLE GAIN AND THE VHF AMATEUR

By George A. (Al) Olcott, K7ICW
Edited by Fred Brown, W6HPH

What is obstacle gain? It is evident that many VHF/UHF hams are unaware of the importance of obstacle gain, or how to recognize it when it exists. The term applies to mountain obstructed paths and represents the gain in signal strength over what would prevail under normal conditions with no mountain present.

Many VHF hams that I have talked to, especially the group at the West Coast VHF conference last year, seem quite impressed about the tropospheric paths that quite often open up along the California coast and valley areas, but little was mentioned of work being done to areas outside of those with a heavy VHF/UHF population or to the so-called "unworkable" areas over the mountains. In my own situation (Las Vegas, Nevada), stations in the San Joaquin Valley of California are inaccessable to me on VHF except by sky-wave propagation; i.e., skip, backscatter, meteor scatter, ionospheric scatter, etc. But on my regular schedule work to the Los Angeles area I have found several stations that are present all of the time, noise levels permitting. This is clearly in my experience a case of obstacle-diffracted propagation. For example, I have a very good obstacle to W6DQJ and I can work him with only 100 watts on 144 Mc. W6DQJ is also a 432 man and I believe I will be able to work him on 432 when I am set up on that band.

Several outstanding examples of obstacle gain paths come to mind. One is the well-known 2 meter path between Anchorage and Fairbanks, Alaska using Mt. McKinley as the obstacle. Another less-known path is that between Pomona and Mojave, California where a 3300 Mc. 400 milliwatt carrier has been successfully received using the San Gabriel mountains as the diffraction point on this 70-mile path.

Diffraction is a physical phenomenon whereby waves pass over an obstacle and fill in some of the "shadow" area behind it. In the case of VHF/UHF diffraction over mountains, the signal may be enhanced by ground reflection on either or both sides of the mountain. Ground gain is usually associated with Earth-Moon-Earth paths where the area in front of the antenna facing the moon may produce up to 6 d.b. gain both receiving and transmitting. Ground gain may also exist where extraordinary flat surfaces such as dry lake beds exist in front of the antenna.

The best approach for determining your particular obstacle gain paths is to initially maintain a heavy series of schedules to as many stations in as many obstructed directions as possible, preferably on CW. With some stations the obstacle gain path is so strong, even at hundreds of miles, that a residual signal is audible on nearly any beam heading.

In summary, proper recognition of an obstacle gain path may produce results for some stations that other stations in a nearby location may not begin to approach regardless of the apparent location advantage (such as being on a hill) or the equipment used. About the only thing you can do at your location to produce results in some cases is to improve your equipment or wait around for favorable propagation of some other type. Another way might be to find another well-equipped station at the other end of the path which might be more favorably located from an obstacle gain standpoint. End.

VHF QSO PARTY SKEDS WANTED

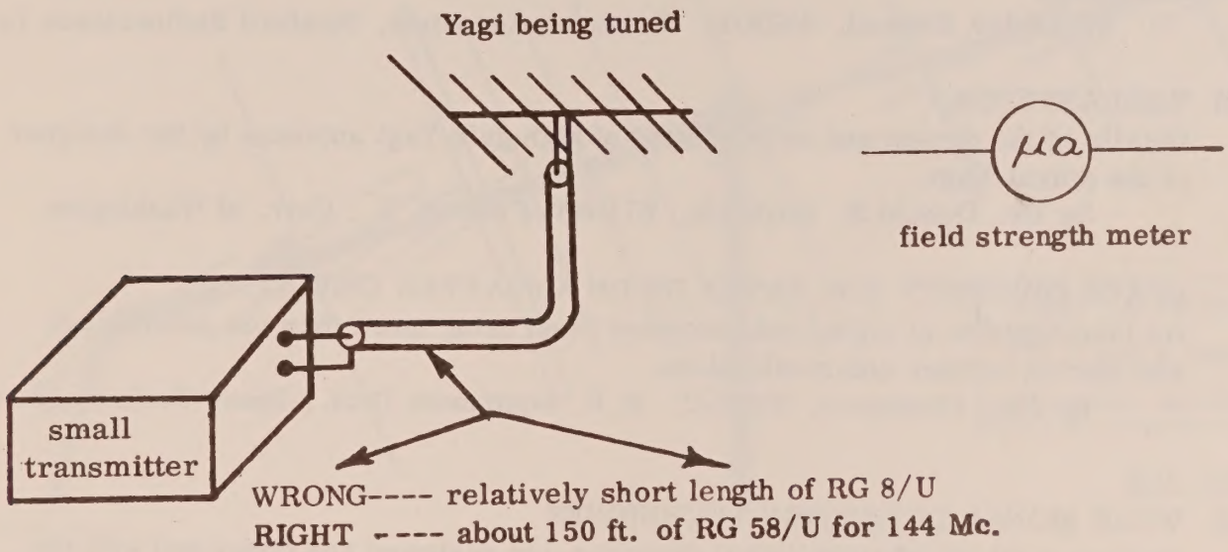
The Tektronix ARC will be on Paulina Peak (8000 ft.) in eastern Oregon during the June party with equipment from 50 thru 432 Mc. They want skeds in British Columbia, Idaho, Nevada, Utah and all of California. Write Gene Single, Tektronix, Box 500, Beaverton, Ore.

The VHF contingent of the Fullerton, Calif. radio club will be operating during the June contest from Diamond Bar Peak in the Orange section. They will be using the call W6ULI/6 on all bands from 50 thru 1296 Mc. High power on all bands except 220, vertical & horiz. polarization, CW and SSB on 50 & 144. Looking for skeds on 50 & 144 tropo scatter. Will have a 16 db. rhombic array on 50 Mc. CW pointed at Denver. Skeds on 432 & 1296 are also badly needed. Please write Bruce Clark, K6JYO, 1019 El Dorado Dr., Fullerton, Calif.

TUNING VHF YAGIS BY THE FIELD STRENGTH METHOD

By Loren Parks, K7AAD

Antenna tuning information is hard to come by. Fred Brown's article in the May, 1963 CQ is the only one I know of. I don't really prefer the field strength method to be described, but it will work OK if you do it right. Its advantage is that it requires a total of one antenna--the one you're tuning. Like most everyone else, I started tuning antennas by field strength and was at that time too dumb to know what I was doing. Later, when I got a power oscillator and started making gain measurements I found out what the problem was. I've never seen this written up before and I offer it as both food for thought and a workable method. I think there are better ways, but this will do you a good job and give you a better antenna than most commercials.



The difference between wrong and right is in the transmission line. The long line of RG 58/U is lossy and at 144 Mc. will have an attenuation of about 10 d.b. This means nine-tenths of the power is absorbed by the line, 10 percent possibly by the antenna. Here is the reason why you need to do this. Every time you move an element near the dipole on a Yagi you change the impedance of the dipole and the load the transmission line sees. If you peak for maximum field strength and use a relatively short, low-loss line, what you are actually doing is adjusting for maximum transfer of power from the transmitter to the antenna. This is NOT what you want to do. What you REALLY want to do is adjust the antenna to deliver maximum field strength when it is driven from a 50 ohm resistive source if you plan to use it with 50-ohm coax. But you do not know the output impedance of your transmitter. So if it isn't 50, and it probably isn't adjusted that way, you are actually using the short transmission line as an impedance transforming device to draw maximum power from the transmitter. As soon as you change line length you're de-tuned---both transmitter AND antenna. If your transmitter output impedance was near 50 ohms when you did your tune up, you are OK. Your reflected power meter can lie to you under certain circumstances (see Nov. 64 VHFER).

Now if you use the lossy line, the transmitter works into a nearly constant load regardless of changes in dipole impedance. It makes no difference what the transmitter output impedance is as far as antenna tuning is concerned. The lossy line looks like a generator with a 50 ohm internal impedance to the antenna (resistive.) This is ideal. So when you tune for maximum field strength at a particular frequency the antenna remains tuned no matter how long or short a line you use thereafter. This is because maximum field strength results when the load (antenna) matches the source impedance (50 ohm line.)

Now just a little bit on construction and techniques. Do NOT use a gamma match if the centers of your elements are grounded to the boom. I have never seen a gamma matched antenna do a decent job made that way. I don't believe it can. Use a symmetrical feed--center fed dipole

(continued on back cover)

OFFICIAL VHF PROGRAM FOR THE 1965 ARRL NATIONAL CONVENTION
San Jose, California

July 3

1 to 2 PM THE WORLD ABOVE 50 MC.--PAST, PRESENT & FUTURE
Highlights and history of amateur VHF activity. What has been accomplished and what to expect in the future.
by Ed Tilton, W1HDQ VHF Editor, QST magazine

2-3 PM MOONBOUNCE
An evaluation of the criteria necessary to calculate system feasibility for this amateur propagation mode. Working systems will be demonstrated with tapes and slides.
by Taylor Howard, W6UGL Research Associate, Stanford Radioscience Lab.

3 to 4 PM YAGI ANTENNAS
Details of the design and development of high gain Yagi antennas by the designer of the spiral Yagi.
by Dr. Donald K. Reynolds, K7DBA Prof. E. E., Univ. of Washington

4-5 PM SPACE DIVERSITY FOR EXTRA DB ON A SCATTER CIRCUIT
An investigation of signal enhancement when using more than one antenna per site during scatter communications.
by John Chambers, W6NLZ R. F. Equipment Dept., Space Technology Lab.

July 4

11-12 AM WEAK SIGNAL DETECTION TECHNIQUES
Various methods of weak signal detection are reviewed and compared with the emphasis on "Fitting the receiver to the expected signal."
by Hank Olson, W6GXN Research Assoc. Stanford Research Institute

1-2 PM ANTENNA MATCHING TECHNIQUES
A discussion and demonstration of practical methods of matching the feedline to the antenna utilizing techniques of the late Oliver Wright, W6GD.
By Bob Melvin, W6VSV President, Melvin Sales, and Jack Trollman, WB6JZY, Sylvania Antenna Engineer.

2-3 PM WHAT CAN BE WORKED ON VHF
A presentation of the various modes and methods for communicating beyond line of sight at VHF, including actual recordings of historic amateur firsts.
by Alan Margot, W6FZA President, Communications Engineering Co.

3-4 PM NOISE FIGURE MEASUREMENT
An analysis and demonstration of low-noise amplifier design and measurement techniques utilizing both amateur and commercial noise-figure-measuring equipment.
by Loren Parks, K7AAD Parks Electronics Lab. & Editor of the VHFER, and Denton E. Nelson, W7UHF, Parks Electronics Lab.

July 5

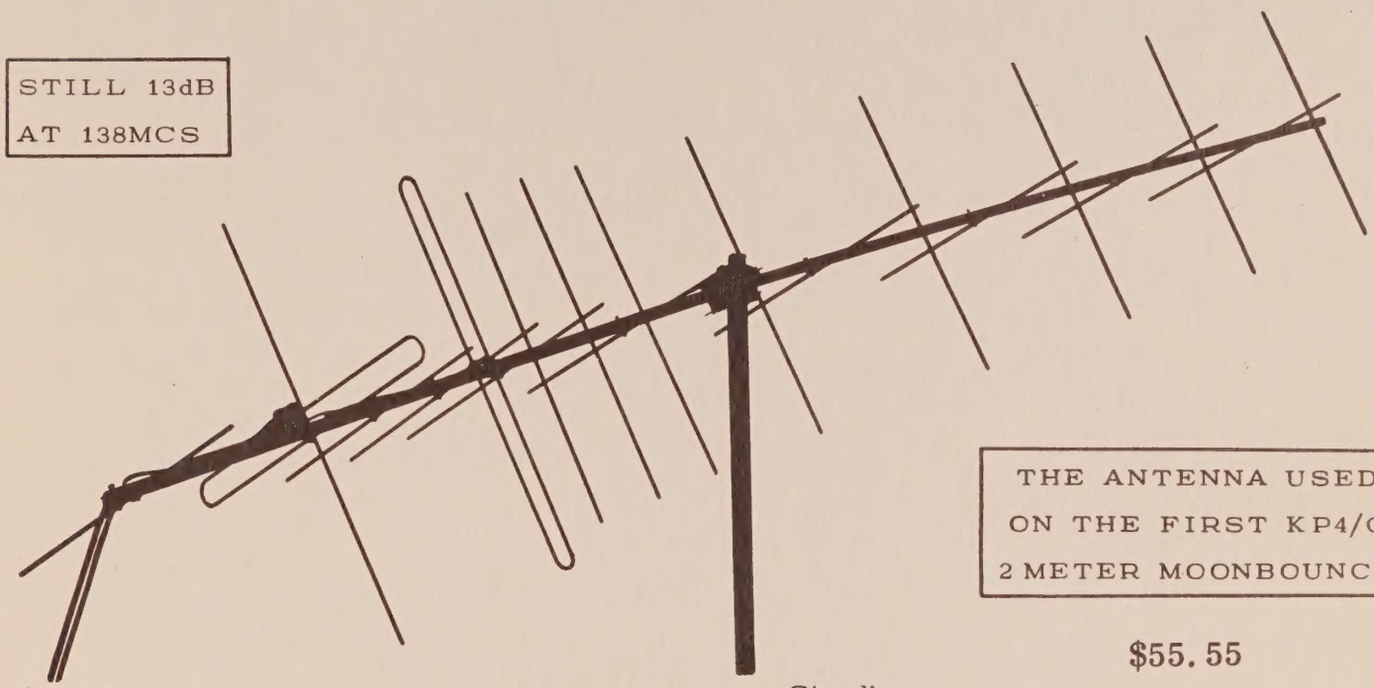
9-12 AM ANNUAL WEST COAST VHF CONFERENCE ANTENNA MEASURING CONTEST
An opportunity for amateurs to measure the actual gain of their favorite 432 or 1296 Mc. antenna using calibrated laboratory equipment. Prizes and trophies will be awarded to the owners of the antennas measuring the highest gain. The antenna must be of such size that it can be supported by one person and have a 50-ohm type N fitting feed point.

THE J BEAM

MOONBOUNCER

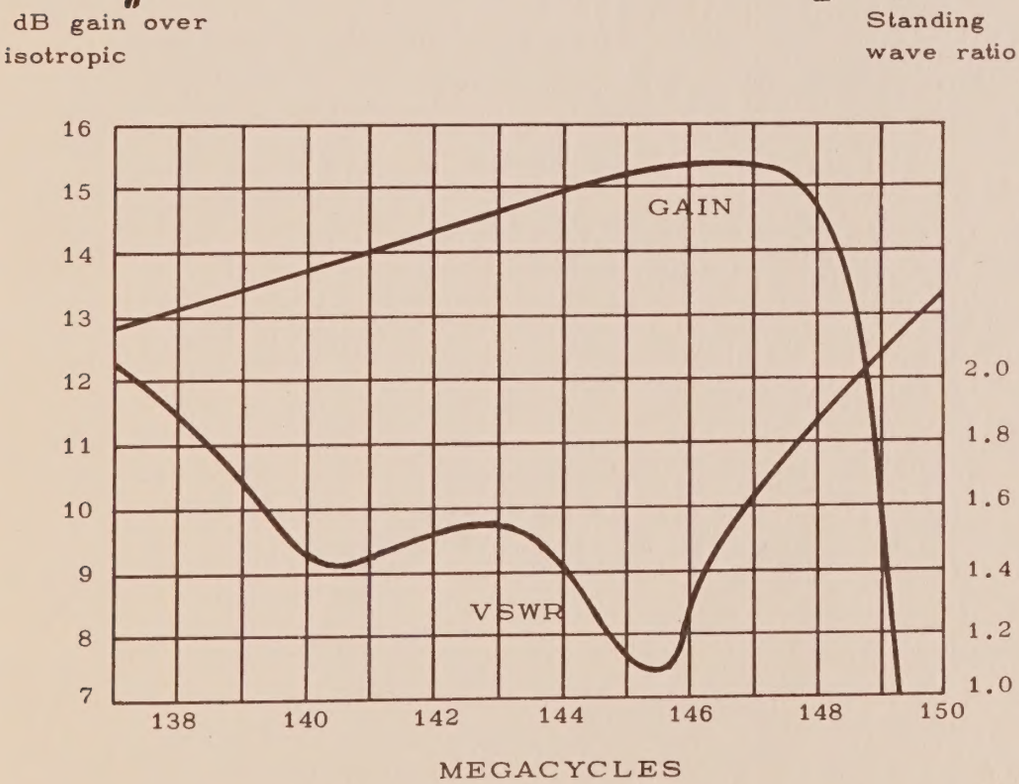
SATELLITE TRACKING ANTENNA

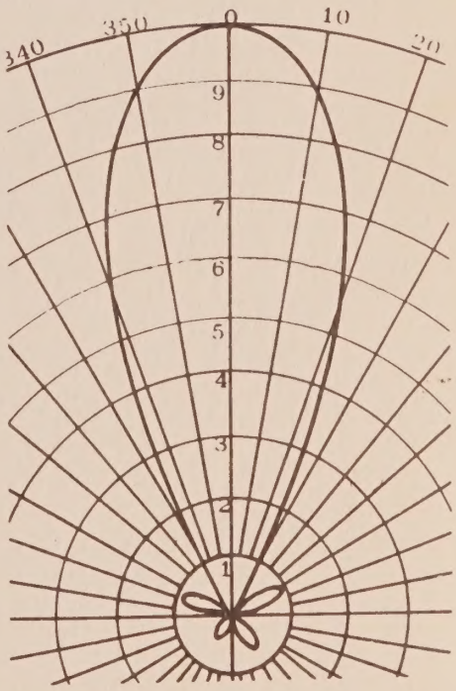
STILL 13dB
AT 138MCS



THE ANTENNA USED
ON THE FIRST KP4/G
2 METER MOONBOUNCE

$55.55





Gain over isotropic	15.4dB	Turning Radius	104"
Front/back ratio	30dB	Net Weight	13.9lbs
½Power beamwidth	33°	Stacking distance above or alongside	132"
Boom length	194"	Wind area	3.4sq.ft.
Width	41"	Wind load at 100mph	83 lbs.

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or folded dipole. Drive a center-fed dipole (which I prefer) with a 1 to 1 balun like that described in the April issue for the reference dipole but do not remove any of the dielectric. Drive a folded dipole with a 4 to 1 or the 1 to 1 balun and forget about match because that will take care of itself if you tune properly. Take dipole lengths out of the handbook if you wish. When you adjust the first director and the reflector for maximum field strength you are matching the dipole-balun combination to the line as well as adjusting phasing. Start with the first director ahead of the dipole. Leave the reflector off till all directors are tuned. Adjust both its length and spacing for maximum field strength. Experimentally change the length by putting alligator clips on or near the ends. The element mounts we advertise are very, very handy because they can be slid along the boom while you adjust. Then when you're finished you drill the hole, put in the screw and you're done. Otherwise when you drill the boom you have de-tuned somewhat, depending on which band you're on and the width of your boom. Run that first element fairly close to the dipole so it couples well--like .1 to .15 wavelength. For an antenna with a dipole and a single director, a director that is too short will peak farther away, too long will peak too close. Use the length that gives you maximum field strength and that will occur fairly close but it will not be a permanent setting. Now add a director that is a little shorter. It will peak farther away and you will re-adjust the first director a bit. Add additional directors building up field strength and re-optimize the spacing. If spacing turns out to be more than .2 wavelength lengthen the directors a bit so they will move in closer. When that is all done, bring in the reflector and peak. If you are coupled well to the first director the reflector won't have a lot of effect on forward gain. Some adjust it for best rejection of signals off the back. Re-juggle reflector and first director for maximum. Tie things down and you're done. At 2 meters all this can be done 5 feet off the ground.

Now I did not say this was the way to adjust long, long Yagis. I am referring to Yagis of moderate length, like 4 to 10 elements. I did not say this would give you maximum possible gain. I did say it will give you more gain than most commercial antennas and a very satisfactory antenna. I urge you to use the balanced drive. On an unbalanced antenna you can bring your hand near the element ends and find that one side of the element is "hotter" than the other. On a good antenna you will find that bringing your hand near the ends of the dipole and first director has a strong detuning effect and that the effect is gradually lessened as you move down the beam. On a poorly tuned antenna you will find some elements cold--so much that they can be removed entirely without appreciably affecting the field strength. That's the kind most of you have. End.

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